

LETTER TO THE EDITOR:

Hypoxia During Upper GI Endoscopy: There is Still Room for Improvement

Editor's note: In this Letter to the Editor, a reader details the challenges in maintaining adequate oxygenation and ventilation during upper GI endoscopy. This topic is related to the feature article on Non-Operating Room Anesthesia in this issue of the Newsletter (see page 3).

Upper endoscopies, even “simple” esophago-gastro-duodenoscopies (EGD’s), are challenging, potentially high-risk anesthetics for a number of reasons. They are by definition “shared airway” cases. They are also “reduced airway access” cases, since the patient is typically placed in the lateral, semi-prone, or prone position, greatly reducing the anesthesia professional’s access to the airway. Teeth can be dislodged by the bite block. Underlying pathologies (esophageal reflux, dysphagia, food impactions, GI bleeds, anemia, preparation for bariatric surgery) put these patients at risk for airway-related complications. Many are performed in procedure rooms with no anesthesia machine in case of an airway emergency and in locations remote from backup resources in the operating room. Rooms are darkened to allow the gastroenterologist a better view of the monitor screen. High case volume, quick case time, and room turnover pressures place time stress on the anesthesia professional, and can lead to the temptation to try to hurry the sedation, which can lead to “stacking” of doses of sedative agents, resulting in even deeper-than-desired levels of sedation. Computerized anesthesia records can create distractions for the anesthesia team, and can often force them to turn their back to the patient to face the computer screen.

Upper endoscopies often require very deep sedation bordering on general anesthesia to suppress the gag, cough, and laryngospasm reflexes, especially with initial insertion of the endoscope. Subsequently, the level of stimulation (and depth of sedation) can vary suddenly and significantly. Upper endoscopies are also, by definition, foreign body obstruction cases, since a large foreign body, the endoscope, is placed into the aero-digestive tract, often producing partial airway obstruction. Sedation reduces muscle tone of the upper airway, which may result in airway collapse that anesthesia professionals must commonly manage.¹

The diameter of commonly used adult esophago-gastrosopes is 8.8-11 mm.² If we apply the formula for the area of a circle, $A = \pi r^2$, it becomes evident that the cross-sectional area of a 9 mm endoscope often exceeds the cross-sectional area of the airway documented on CT studies,^{3,4} thereby presenting a risk for partial or even total obstruction of the airway in a significant percentage of patients. The Guardus® Overtube (US Endoscopy, Mentor, OH), a clear plastic tubular device placed over the endoscope to create aerodigestive separation for removal of

impacted food, has an even larger outer diameter of 19.5 mm.⁵

Another major challenge in delivering sedation for upper endoscopy has been the limitation of our supplemental oxygen delivery systems. Traditional oxygen facemasks for upper endoscopy are typically not used as they impair access to the mouth by the endoscopist. Often, the mode of oxygen delivery is one of our least effective: nasal cannula (or, insufflation via an oral catheter).

Standard nasal cannulae are recommended to be used at maximal O₂ flows of 5–6 L/min.⁶ Even short durations of higher rates are not well tolerated because of discomfort and drying of the nares that may result in epistaxis. At O₂ flows of 6–7 L/min, nasal cannulae provide a maximum FiO₂ of approximately 0.44–0.62.⁶ Other common clinical conditions, such as nasal congestion, nasal polyps, or septal deviation can further reduce the oxygen delivery from a nasal cannulae. By contrast, O₂ face masks with non-rebreathing reservoirs, at O₂ flows of 9–15 L/min, comfortably provide much higher FiO₂’s of approximately 0.90–0.95.

Given the issues of airway encroachment and the potential for limited oxygen delivery, airway management during upper endoscopy under sedation is, by its very nature, “high risk.” Therefore, anesthesia professionals should approach these cases similar to the way we approach patients requiring general anesthesia in the operating room—by remembering the time-tested principles of “safe apneic time” and “maximal preoxygenation.”

“Safe apneic time” is defined as the delay from the onset of apnea until the SpO₂ drops to below 90%, into the steep portion of the hemoglobin-O₂ desaturation curve and into critically low levels. The safe apneic time in healthy adults is approximately less than one minute.⁷ However, patients with decreased capacity for oxygen loading (e.g., anemia, pulmonary disease, obesity, decreased cardiac output, or decreased functional residual capacity), or with increased oxygen demand (fever, hypermetabolic state) desaturate much more quickly.⁸⁻¹⁰

It has been established for decades that the simple technique of “maximal preoxygenation” can double or even triple safe apneic time.^{7,9} In a classic 1999 editorial in *Anesthesiology*, Dr. Jonathan Benumof wrote: “The purposes of maximally preoxygenating before the induction of general anesthesia are to provide the maximum time that a patient can tolerate apnea, and for the anesthesia professional to solve a cannot-ventilate/cannot intubate situation. Moreover, because a cannot ventilate/cannot intubate situation is largely unpredictable, the desirability to maximally preoxygenate is theoretically present for all patients.”¹⁰ Dr. Benumof



Endoscopy Suite

vigorously espoused maximal preoxygenation whenever possible. Preoxygenation has become standard practice for many practitioners prior to all general anesthetic inductions (i.e., iatrogenically-induced apnea).^{8,9}

There are several accepted methods of effective maximal preoxygenation.^{10,11} Many techniques used by anesthesia professionals require O₂ flow (>10L/min) through a well-fitting oxygen mask. The most effective and efficient may be the “8 DB/60 sec” (8 deep breaths over 60 seconds) method described by Baraka.^{10,11} Dr. Benumof’s logic, which has served our patients so well for decades in the potentially high-risk situation of induced apnea in the operating room, should be extended to patients undergoing upper endoscopy under sedation, particularly if this can be done simply and cost-effectively.

In recent years, there have been several oxygen masks designed specifically for upper endoscopy procedures.¹ These oxygen masks deliver reliably high oxygen concentrations while providing capnography monitoring capabilities and easy endoscopic access.

Capnography and vigilance allow rapid diagnosis of severe hypoventilation, even in a dark room with the patient facing away from us. There are now available endoscopy oxygen facemasks and other devices that make the goal of providing near-maximal preoxygenation prior to the start of deep sedation attainable. These devices may prolong safe apneic time to allow intervention prior to the onset of severe hypoxia.¹

Improving the safety of the patients we serve requires continual re-assessment of our practices, and a willingness to improve where possible. Since 1955, we have had a simple method, “maximal preoxygenation,” available to prolong safe apneic time.¹² In 2019, there is equipment available enabling us to approximate “maximal pre-oxygenation” prior to induction of hypopnea and insertion of an obstructive endoscope into the upper airway. In his “2019 President’s Report,” Dr. Mark Warner, reiterated the APSF’s vision that “no patient shall be harmed by anesthesia,” and implores us all to continue to work on “this noble quest.”¹³

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Therefore, our goal should be zero tolerance for hypoxia during upper endoscopies. There is room and opportunity for improvement.

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LETTER TO THE EDITOR:

Should Medication Labels be Color-Coded?

I read the Pro/Con Debate: Color-Coded Medication Labels in the February 2019 issue of the APSF Newsletter with interest. I found that the companion article "Pro: Color-Coded Medication Labels Improve Patient Safety" provided a reasonable argument for use in clinical practice. However, there are several issues with the Con argument presented. First, Dr. Litman suggests that we should not use color coding because the variety of suppliers do not use the same coding. It would appear that if we accept this notion, we are accepting the present flawed dogma. National organizations may seek ways to urge producers of medications to consider standardizing the colors of their labels. The next reason quoted by Dr. Litman is that those providers that are colorblind will not be able to distinguish label colors. However, for those that are colorblind, it would seem that an emphasis on reading the printed label would be most prudent. This is something we are all expected to do anyway. Another argument proffered is that nurses outside of the operating room may not be familiar with color-coding. However, I see this as an opportunity to educate providers on the value of color-coding medications and standardizing this process throughout hospital care.

Several organizations have expressed concern about color-coding of medication labels. Yet none of them specifically address the high acuity of medication administration in the operating room. Seconds count in giving life-saving medications. Anesthesia professionals are hampered by lighting and patient positioning when administering medications. This work environment is different from anywhere else in patient care. For good reason already, by federal regulation, medical gases must be labeled and color-coded (21 CFR § 201.328).

Organizations such as the Anesthesia Patient Safety Foundation should strongly assert their mission that "no patient shall be harmed by

anesthesia care." We need to emphasize our work with suppliers of medications and labeling devices to facilitate standardization of medication color labeling. Many industry representatives already ask for our guidance. We need to impress upon our purchasers of medications to only buy compliantly packaged medications, with labels and vial caps complying with the appropriate national guidelines on medication labeling.

*Sincerely,
H.A. Tillmann Hein, MD*

Dr. Hein is founder and managing partner of Metropolitan Anesthesia Consultants, LLP, Dallas, TX, and clinical professor of Anesthesiology and Pain Management at The University of Texas Southwestern Medical School. He also serves on the Committee on Quality Management and Departmental Administration for the ASA.

Dr. Hein has no conflicts of interest pertaining to this article.

RESPONSE:

The purpose of the "Con" perspective was to emphasize the fallibility of reliance on color coding, and to bring awareness to the anesthesiology community that better technological advances (i.e. bar-coding devices) now exist. Although it is not substantiated by epidemiological evidence, it would seem that the combination of colored labels plus confirmatory bar-coding (or another similar technological solution) would be an ideal solution to minimize the incidence of syringe swap. Reliance on an anesthesia professional to prevent errors by always reading the name of the drug on the label each and every time is naïve, as human error is not preventable, and arguably normal. We now have the ability to improve upon outdated and unreliable safety systems, and they should be used. The Institute



for Safe Medication Practices (ISMP) has been a proponent of color coding with regard to the American Society for Testing and Materials (ASTM) standard for anesthesia professional applied labels and for outsourced syringes used in the OR. The caveat is that these same color-coded syringes are also not relied upon in other areas of the hospital by non-anesthesia personnel, where same-class syringe mix-ups have occurred. The consequences of an accidental syringe swap error on a hospital ward are likely to be far worse outside the continuously monitored operating room environment. The overarching message of our "Con" approach to color-coding should not be focused on whether or not the color increases or decreases syringe swap, but rather on the need for additional systems-based safety mechanisms (i.e., bar-coding) that provide additional safety to medication administration by anesthesia personnel.

*Sincerely,
Matt Grissinger, RPh, and Ron Litman, DO*

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Neither author has any conflict of interest pertaining to this article.

Editor's Note: Our editor's group modified the original title of the article from Matt Grissinger and Ron Litman to reflect the authors' opposition to the reliance of providers on color coded syringes that may provide false reassurance. They do not oppose color coding altogether.